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Amendment Responsive to Office Action of April 7, 2004
August 9, 2004
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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A knotless suture anchor apparatus for anchoring a length of suture with respect thereto, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end; [and]

bone anchoring structure for securing said anchor body within adjacent bone; and
a plurality of suture-locking elements located within the anchor body lumen and each movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining a generally uniform cross-section axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions converting the cross-section of the axial passage to be irregular and therefore substantially restrict axial movement of the length of suture therethrough.

2. (Original) The apparatus of claim 1, wherein the axial passage is located generally in the center of the lumen and the suture-locking elements each move toward the center of the lumen from their first to their second positions.

3. (Original) The apparatus of claim 2, wherein the suture-locking elements are substantially C-shaped and each surrounds and defines approximately three-quarters of the axial passage.

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4. (Original) The apparatus of claim 2, wherein at least one of the suture-locking elements moves in a different direction than the others from their respective first to their second positions.

5. (Currently Amended) The apparatus of claim 4 32, wherein there are at least three suture-locking elements that are stacked axially and arranged to move radially within the lumen, and wherein adjacent suture-locking elements move in opposite directions.

6. (Original) The apparatus of claim 5, wherein the suture-locking elements are substantially C-shaped and each surrounds and defines approximately three-quarters of the axial passage.

7. (Currently Amended) The apparatus of claim 4 32, and further including:
a pair of suture-locking plugs that are axially displaceable within the lumen so as to contact different suture-locking elements and move them in different directions from their first to their second positions.

8. (Original) The apparatus of claim 1, wherein the suture-locking elements are arranged to move radially within the lumen from their first to their second positions.

9. (Currently Amended) The apparatus of claim 8, and further including:
a suture-locking plug that is axially displaceable within the lumen so as to contact at least some of the suture-locking elements and move them from their first to their second positions.

10. (Currently Amended) The apparatus of claim 9 33, wherein there are at least three suture-locking elements that are stacked axially and arranged to move radially within the lumen, and wherein adjacent suture-locking elements move in opposite directions.

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11. (Currently Amended) A knotless suture anchor apparatus for anchoring a length of suture with respect to a body cavity, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end, the anchor body being sized to fit within the body cavity; and

bone anchoring structure for securing said anchor body within adjacent bone; and

a plurality of suture-locking elements radially movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining at least one axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions reducing the size of the passage so as to clamp the length of suture therein and substantially restrict axial movement of the length of suture therethrough.

12. (Original) The apparatus of claim 11, wherein the axial passage is located generally in the center of the lumen and the suture-locking elements each move toward the center of the lumen from their first to their second positions.

13. (Original) The apparatus of claim 12, wherein the suture-locking elements are substantially C-shaped and each surrounds and defines approximately three-quarters of the axial passage.

14. (Original) The apparatus of claim 12, wherein at least one of the suture-locking elements moves in a different direction than the others from their respective first to their second positions.

15. (Currently Amended) The apparatus of claim ~~14~~ 35, and further including:
a pair of suture-locking plugs that are axially displaceable within the lumen so as to contact different suture-locking elements and move them in opposite directions from their first to their second positions.

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16. (Currently Amended) The apparatus of claim 11, and further including:
a suture-locking plug that is axially displaceable within the lumen so as to contact
at least one of the suture-locking elements and move it from its first to its second
position.

17. (Currently Amended) The apparatus of claim ~~16~~ 36, wherein the suture-
locking plug has a first cross-sectional size and further including an actuation rod having
a second cross-sectional size smaller than the first, the actuation rod being removably
attached to the proximal end of the suture-locking plug and projecting out of the proximal
end of the anchor body, the actuation rod being used to displace the suture-locking plug
axially within the lumen.

18. (Original) The apparatus of claim 17, and further including a point of tensile
weakness along the actuation rod, thereby permitting the wire to be detached from the
suture-locking plug upon application of a predetermined tensile force on the actuation rod
in the proximal direction after each of the at least one contacted suture-locking elements
have moved from their respective first positions to their respective second positions.

19. (Currently Amended) The apparatus of claim ~~16~~ 36, wherein there are at least
two suture-locking elements that are stacked axially and arranged to move radially within
the lumen, and wherein adjacent suture-locking elements move in opposite directions.

20. (Currently Amended) The apparatus of claim ~~16~~ 36, wherein there are two of
the axial passages and two lengths of suture, each located on diametrically opposed sides
of the lumen and against the anchor body wall, wherein the suture-locking elements each
move toward one of the axial passages when displaced from their first to their second
positions.

21. (Original) The apparatus of claim 20, wherein each suture-locking element
has an aperture offset from the center of the lumen, which the suture-locking plug

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contacts to displace the suture-locking element, the apertures of adjacent suture-locking elements being offset in different directions such that axial displacement of the suture-locking plug moves adjacent elements in different directions.

22. (Original) The apparatus of claim 11, wherein the anchor body further includes a suture return member fixed with respect thereto such that the length of suture may be passed into lumen from the proximal end, through the axial passage, looped around the suture return member, back through the axial passage, and passed out of the lumen through the proximal end.

23. (Original) A method of securing soft tissue with respect to a body cavity without knots, comprising:

passing a length of suture through soft tissue so that a loop of suture material is embedded in the soft tissue resulting in two free ends;

providing an anchor body having an open proximal end and a lumen, and a plurality of suture-locking elements located within the anchor body lumen and each movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining a generally uniform cross-section axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions converting the cross-section of the axial passage to be irregular and therefore substantially restricting axial movement of the length of suture therethrough;

passing the two free ends of the length of suture into the lumen of the anchor body through the open proximal end and through the passage with the suture-locking elements in their first positions, and extending the two free ends out of the lumen through the open proximal end;

fixing the anchor body with respect to a body cavity;

tightening the loop of suture material by pulling on one or both of the two free ends of the length of suture; and

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fastening the two free ends of the length of suture with respect to the anchor body without the use of knots by displacing the suture-locking elements to their second positions.

24. (Original) The method of claim 23, wherein the soft tissue is a tendon, and the body cavity is formed in a bone.

25. (Original) The method of claim 24, wherein the tendon is the rotator cuff tendon, and wherein the bone is the humeral head.

26. (Original) The method of claim 23, wherein the step of fixing the anchor body with respect to the body cavity comprises forming the body cavity, passing the anchor body into the body cavity, and radially expanding anchoring structure on the anchor body.

27. (Original) The method of claim 26, wherein the body cavity is a cylindrical tunnel formed in a bone, and wherein the anchoring structure is provided on a proximal end of the anchor body so as to interfere with the cortical layer of the bone and prevent proximal removal of the anchor body from the cylindrical tunnel.

28. (Original) The method of claim 23, and further including a step of providing a suture-locking plug that is axially displaceable within the lumen so as to contact at least some of the suture-locking elements and move them from their first to their second positions.

29. (Original) The method of claim 28, wherein at least one of the suture-locking elements moves in a different direction than the other suture-locking elements, from their respective first to their second positions, said suture-locking plug being displaced axially to move the suture-locking elements in different directions.

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30. (Original) The method of claim 28, wherein at least one of the suture-locking elements moves in the opposite direction of the other suture-locking elements, from their first to their second positions, said suture-locking plug providing step including providing two suture-locking plugs, said two suture-locking plugs being axially displaced to move different suture-locking elements in opposite directions.

31. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect thereto, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end; and

a plurality of substantially C-shaped suture-locking elements located within the anchor body lumen and each movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining a generally uniform cross-section axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions converting the cross-section of the axial passage to be irregular and therefore substantially restrict axial movement of the length of suture therethrough;

wherein the axial passage is located generally in the center of the lumen and the suture-locking elements each surround and define approximately three-quarters of the axial passage and move toward the center of the lumen from their first to their second positions.

32. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect thereto, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end; and

a plurality of suture-locking elements located within the anchor body lumen and each movable within the lumen from respective first positions to second positions, the

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locking elements in their first positions together defining a generally uniform cross-section axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions converting the cross-section of the axial passage to be irregular and therefore substantially restrict axial movement of the length of suture therethrough;

wherein the axial passage is located generally in the center of the lumen and the suture-locking elements each move toward the center of the lumen from their first to their second positions and further wherein at least one of the suture-locking elements moves in a different direction than the others from their respective first to their second positions.

33. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect thereto, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end;

a plurality of suture-locking elements located within the anchor body lumen and each movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining a generally uniform cross-section axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions converting the cross-section of the axial passage to be irregular and therefore substantially restrict axial movement of the length of suture therethrough; and

a suture-locking plug that is axially displaceable within the lumen so as to contact at least some of the suture-locking elements and move them from their first to their second positions.

34. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect to a body cavity, comprising:

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an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end, the anchor body being sized to fit within the body cavity; and

a plurality of suture-locking elements radially movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining at least one axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions reducing the size of the passage so as to clamp the length of suture therein, the axial passage being located generally in the center of the lumen and the suture-locking elements each moving toward the center of the lumen from their first to their second positions;

wherein the suture-locking elements are substantially C-shaped and each surrounds and defines approximately three-quarters of the axial passage.

35. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect to a body cavity, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end, the anchor body being sized to fit within the body cavity; and

a plurality of suture-locking elements radially movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining at least one axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions reducing the size of the passage so as to clamp the length of suture therein, the axial passage being located generally in the center of the lumen and the suture-locking elements each moving toward the center of the lumen from their first to their second positions;

wherein at least one of the suture-locking elements moves in a different direction than the others from their respective first to their second positions.

36. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect to a body cavity, comprising:

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an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end, the anchor body being sized to fit within the body cavity;

a plurality of suture-locking elements radially movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining at least one axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions reducing the size of the passage so as to clamp the length of suture therein; and

a suture-locking plug that is axially displaceable within the lumen so as to contact at least one of the suture-locking elements and move it from its first to its second position.

37. (New) A knotless suture anchor apparatus for anchoring a length of suture with respect to a body cavity, comprising:

an anchor body having a proximal end, a distal end, and a lumen opening at the proximal end such that a length of suture may be introduced into the lumen from the proximal end, the anchor body being sized to fit within the body cavity;

a plurality of suture-locking elements radially movable within the lumen from respective first positions to second positions, the locking elements in their first positions together defining at least one axial passage sized to permit axial movement of the length of suture therethrough, and in their second positions reducing the size of the passage so as to clamp the length of suture therein;

wherein the anchor body further includes a suture return member fixed with respect thereto such that the length of suture may be passed into the lumen from the proximal end, through the axial passage, looped around the suture return member, back through the axial passage, and passed out of the lumen through the proximal end.